DOCUMENT RESUME

ED 237 309 SE 041 715

TITLE Field Trip to a Rocky Shore.
INSTITUTION Maine Univ., Orono. Cooperative Extension Service.
PUB DATE [81]
NOTE 7p.; In its: Connections to the SEA--A 4-H Guide to Marine Education. Maine Cooperative Extension Service, 1981. p9-14.
PUB TYPE Guides - Classroom Use - Materials (For Learner) (051)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Environmental Education; *Field Instruction; *Field Trips; Learning Activities; *Marine Biology
IDENTIFIERS Coastal Zones; *Maine; PF Project

ABSTRACT

Field trip activities designed for use on Maine's coast are provided, with brief definitions of the major physical zones to be found in this area. An introduction to the study of zonation of plants and animals living on the rocky shore is presented along with a list of the materials needed and the procedures to be followed when making a study of the coast. A matrix shows the different organisms and their means of wave survival, protection from drying, and method of feeding in the Irish Moss Zone and Rockweed Zone. Data sheets are provided for the purpose of listing the plants and animals found, their approximate numbers, their type of environment, and their survival tactics in that environment. (JW)

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# FIELD TRIP TO A ROCKY SHORE*

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Welcome to the Maine coast. While some flat, sandy beaches do exist in Maine, the major part of the coast is rugged and rock-lined. It is clearly described by Howard M. Weiss and Michael W. Dorsey in their book *Investigating the Marine Environment:*

"The rocky shore is a severe and rugged environment. It is battered by surf and covered by salty water with each incoming tide and during storms. The rest of the time it is exposed to the heat and radiation of the sun, to icy winds, to rain and snow, and to the blistering heat of summer and the bitter cold of winter. The plants and animals that live here must be as rugged as this environment.

"Rocky shore organisms must be able to hold tight to sheer rocks to keep from being washed away. They must resist abrasion as they are scraped by rocks and bounced about by the turbulent water. They must be able to withstand exposure to salty sea water and fresh rainwater and other changes that occur as the tide rises and falls.

"In certain places the rocks form basinlike depressions that hold water as the tide recedes. Conditions in these basins, or tide pools, are harsh and unpredictable. When they are exposed to air, the sun can heat them up to the temperature of a warm tub. The sun's heat evaporates the water, increasing the salinity (salt content) higher than that of the open ocean. When it rains, the basin is filled with fresh water, and the salinity can drop to zero. Although the rocky intertidal zone is a harsh environment, a surprisingly large number of different plants and animals live there.

"Within a short distance, the environment on the rocky shore changes from completely marine to completely terrestrial. This makes it an ideal place to study how the distribution of animals is affected by the environment. The organisms living near the low-tide level on a rocky shore are immersed in sea water almost all the time, whereas the organisms living higher up are inundated only at high tide. Different plants and animals tolerate the conditions found at different locations between the tidal levels. Groups of organisms that tolerate similar conditions will generally occupy bands or zones along the shore. As you walk from the land toward the water, you will pass over a number of zones containing different groups of organisms."[1]

On most rocky shores the following areas can be identified:

*Above the tide* – a transitional area extending from the forest down to the spray zone.

*Spray zone* – a black or greyish band found above high tide which sea water reaches regularly by splash or spray action; the black color is caused by the presence of millions of microscopic, individual blue-green algae.

*High tide mark* - a line along the shore caused by the uppermost rise of sea water on a given day; this line varies considerably due to storms, the monthly cycle of the moon, and the annual cycle of the sun.

*Rockweed or intertidal zone* - a yellowish-brown band found between the high and low tide marks which is alternately exposed to air and covered by sea water each day; organisms common in the zone include rockweeds, barnacles, periwinkles, blue mussels, and dog whelks; barnacles often form a distinctive white band between the black splash zone and the rockweeds.

*Tide pools* – places among the rocks between high and low tide marks where seawater is trapped each time the tide goes out.

*Irish moss zone* – a belt of vegetation found below the rockweed zone and near the low tide mark; this zone is dominated by Irish moss and other red algae.

*Low tide mark* – a line along the shore created by the farthest drop of sea water on a given day; as with the high tide mark, this line varies with storms and the cycles of the moon and sun.

*Kelp or subtidal zone* - a band of vegetation located right at or below the low tide mark; common organisms include kelp, sea stars, sea urchins, and sea cucumbers.

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1. Howard M. Weiss and Michael W. Dorsey, *Investigating the Marine Environment: A Sourcebook, Volume 1: Field Studies* (Groton, CT: Project Oceanology, 1980), pp. 37-38

*From Connections to the Sea--a 4-H Guide to Marine Education.

Maine Cooperative Extension Service
pp 9-14



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Following is an activity that will help you locate these various zones and the organisms that live in each. Included is a Field Guide to the Organisms found along the shore to help you identify them. Also helpful is the chart on Rocky Beach Survival which follows the Field Guide.

## ZONATION ALONG A ROCKY SHORE

**Purpose:** To study the zonation of plants and animals living along a rocky shore.

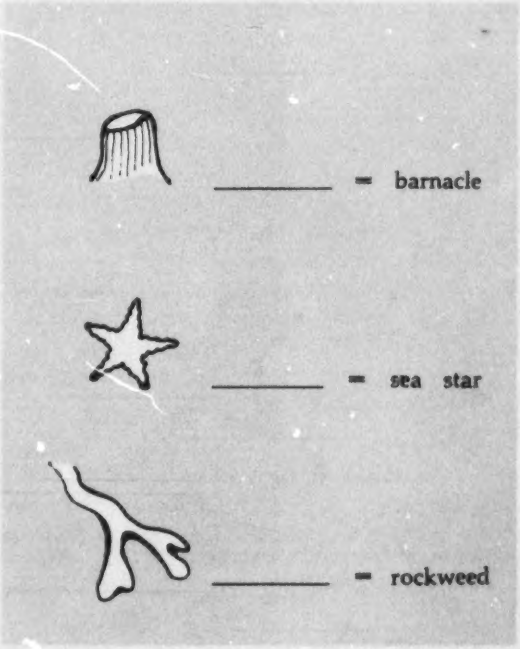
**Introduction:** The rocky shore is a severe and rugged environment. It is battered by surf and covered by salty water with each incoming tide and during storms. The rest of the time it is exposed to the heat and radiation of the sun, to icy winds, to rain and snow, and to the blistering heat of summer and the bitter cold of winter. The plants and animals that live here must be as rugged as this environment. Within a short distance, the environment on the rocky shore changes from completely marine to completely terrestrial. This makes it an ideal place to study how the distribution of animals is affected by the environment.

**Materials and equipment needed:**

Pail for collections
Coat hangers bent into square shape
30 yard line marked at 2 yard intervals
Data sheets or notebook
Clip board
Pencil
Field Guide
Hand lens (optional)

**Procedure:**

1. Plan to arrive at the shore at about one or two hours before low tide.
2. Divide your group into teams of three persons (recorder, investigator, researcher).
3. Starting at the edge of the woods or landward side of the beach, stretch out the transect line at about a right angle to the beach. Place the hanger square (quadrat frame) next to the uppermost marking on the transect line. Place number "1" under quadrat number on the data sheet.
4. Using your Field Guide, identify all the plants and animals that you can which fall inside the quadrat frame. List these on your data sheet.
5. Complete the rest of the information requested on the data sheet: approximate number of each type of organism; description of the environment (rocks, sand, sunny) estimate the elevation above or below the high tide mark and the zone in which your quadrat is located (spray zone, tidal pool, rockweed zone).
6. Continue toward the water using the same procedure for each quadrat. Move the transect line when you reach the end to form a straight line toward the water. Continue until you reach the low tide mark.
7. When you have finished your transect, go back and study in detail the plants and animals you found to discover how they survive. For each organism list: how it survives the crashing waves, how it protects itself from drying, where it lives (niche), and how it gets food. Record these observations on the Rocky Beach Survival Data Sheet.
8. After returning home, prepare a map showing the location of each quadrat along the transect line. Show the location of the high tide mark, low tide mark, and the different zones. Make up symbols for the different organisms you found, such as




Fill in your map with the symbols for the dominant organisms found in each zone.

Your Name_____
Transect #_____
Date_____

## Zonation Along a Rocky Shore
### Data Sheet

| Quadrat Number | Animals | Approx. Number | Plants | Approx. Number | Zone | Environment (rock, sand, etc.) | Elevation (Feet above or below high tide mark) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

Your Name _____
Date _____

## ROCKY BEACH SURVIVAL
**Data Sheet**

Instructions: List the plants and animals found along the rocky shore. Examine and list how each survives.

| PLANT OR ANIMAL | WAVE SURVIVAL | PROTECTION FROM DRYING | NICHE | METHOD OF FEEDING |
|---|---|---|---|---|
| **Example:** Barnacle | attaches to rocks | closes shell tightly | rocks | opens shell, hand-like structure strains food from the water |
| | | | | |
| | | | | |
| | | | |

## ROCKY BEACH SURVIVAL
### The Irish Moss Zone

| ORGANISM | WAVE SURVIVAL | PROTECTION FROM DRYING | METHOD OF FEEDING |
|---|---|---|---|
| anemone | attaches to rocks | withdraws tentacles; covers with shell bits | catches food with tentacles |
| crumb of bread sponge | encrusts rocks | tidal pools; subtidal | passes water through tiny holes; traps food inside |
| fan worm | burrows into mud | burrows into mud | catches food with tentacles |
| sand dollar | lies flat against sand | hard shell; subtidal | cilia move food into mouth |
| sand shrimp | burrows into sand; free swimming | tidal pools; subtidal | strains food through stiff bristles |
| sea cucumber | clings to rocks with tubular feet | tidal pools; subtidal | takes in organic debris with mop-like branches or tentacles |
| sea star | tube feet act as suction cups for clinging | crawls into moist crevices; forms clusters | open bivalve shells with tube feet; extends stomach into shell |
| sea urchin | tube feet act as suction cups for clinging | crawls into rocky crevices | tube feet catch food; move under to mouth with tiny feet |
| slipper shell | holds onto rocks with muscular foot | clamps onto rocks | mouth, located in front of foot, scrapes tiny plants off rocks |
| squirt | embedded in jelly-like substance | tidal pools; subtidal | siphons water through body; traps food inside |
| jellyfish | free swimming | kelp zone; subtidal | catches plankton on sticky bands of umbrella; licks off with mouth arms |

## ROCKY BEACH SURVIVAL
### The Rockweed Zone

| ORGANISM | WAVE SURVIVAL | PROTECTION FROM DRYING | METHOD OF FEEDING |
|---|---|---|---|
| blood worm | burrows into mud | burrows into mud | catches food with hook-like jaws |
| clam worm | burrows into mud | burrows into mud | catches food with horny protruding jaw |
| tube worm | attaches to rocks and seaweed | pulls plume into tube; has plug for end | catches food with plume |
| barnacle | attaches to rocks | closes shell tightly | opens shell; hand-like structure strains food |
| beach flea | above high tide mark | crawls under seaweed | through mouth; scavenger |
| chiton | holds onto rocks with muscular foot | clamps onto rocks | mouth, located in front of foot, scrapes tiny plants off rocks |
| clam | burrows into mud | closes shell tightly | pumps water through shell to filter food |
| dog whelk | holds onto rocks with muscular foot | clamps onto rocks | rasps prey with file-like mouth part |
| dog winkle | holds onto rocks with muscular foot | closes shell tightly | rasps or drills into mussels or other shelled animals |
| limpet | holds onto rocks with muscular foot | clamps onto rocks trapping water under shell; forms clusters in sheltered spots | mouth, located in front of foot, scrapes tiny plants off rocks |
| mussel | attaches to rocks with with byssus threads | closes shell tightly | pumps water through shell to filter food |
| periwinkle | holds onto rocks with muscular foot | clamps onto rocks; retreats into shell | rasps seaweed with tiny file-like mouth part |
| rock crab | crawls under rocks | crawls to moist areas under rocks | uses claws to scavenge |
| hermit crab | crawls under rocks | pulls into shell; crawls to wetter area | uses claws to scavenge |